NP89N04PDK

40 V – 90 A – N-channel Power MOS FET
Application: Automotive

R07DS1016EJ0200
Rev.2.00
May 24, 2018

Description

The NP89N04PDK is N-channel MOS Field Effect Transistors designed for high current switching applications.

Features

- Super low on-state resistance
  $R_{DS(on)}$ = 2.95 mΩ MAX. (V_{GS} = 10 V, I_D = 45 A)
- Low C_{iss}: C_{iss} = 3900 pF TYP. (V_{DS} = 25 V)
- Logic level drive type
- Designed for automotive application and AEC-Q101 qualified

Ordering Information

Part No.	Lead Plating	Packing		Package
NP89N04PDK-E1-AY *1	Pure Sn (Tin)	Tape 800 p/reel	Taping (E1 type)	TO-263 (MP-25ZP)
NP89N04PDK-E2-AY *1			Taping (E2 type)	

Note: *1 Pb-free (This product does not contain Pb in the external electrode)

Absolute Maximum Ratings (T_A = 25°C)

Item	Symbol	Ratings	Unit
Drain to Source Voltage (V_{GS} = 0 V)	V_{DSS}	40	V
Gate to Source Voltage (V_{DS} = 0 V)	V_{GSS}	±20	V
Drain Current (DC) (T_C = 25°C)	$I_{D(DC)}$	±90	A
Drain Current (pulse) *1, 3	$I_{D(pulse)}$	±360	A
Total Power Dissipation (T_C = 25°C)	P_{T1}	147	W
Total Power Dissipation (T_A = 25°C)	P_{T2}	1.8	W
Channel Temperature	T_{ch}	175	°C
Storage Temperature	T_{stg}	–55 to +175	°C
Repetitive Avalanche Current *2, 3	I_{AR}	37	A
Repetitive Avalanche Energy *2, 3	E_{AR}	136	mJ

Thermal Resistance

Channel to Case Thermal Resistance	$R_{th(ch-C)}$*3	1.02	°C/W
Channel to Ambient Thermal Resistance	$R_{th(ch-A)}$ *3	83.3	°C/W

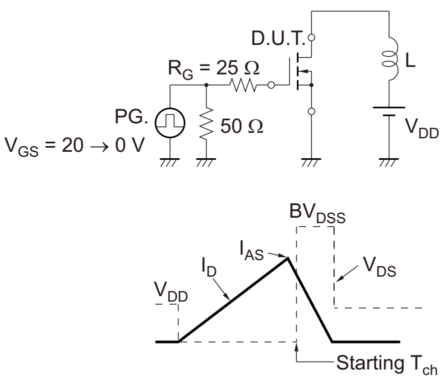
Notes: *1 T_C = 25°C, $P_W \leq$ 10 μs, Duty Cycle ≤ 1%
*2 R_G = 25 Ω, V_{GS} = 20 V → 0 V
*3. Not subject of production test. Verified by design/characterization.

Electrical Characteristics (T_A = 25°C)

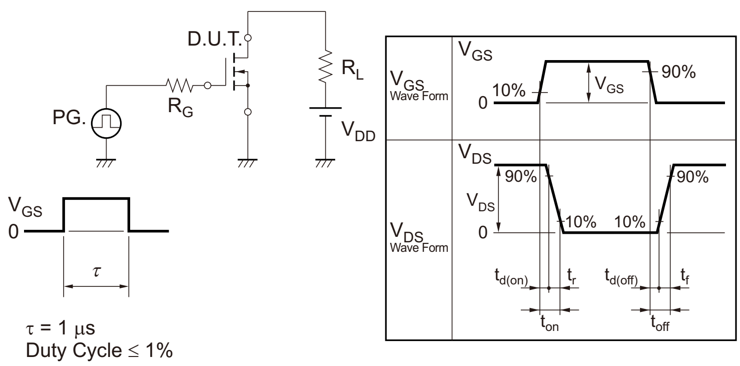
Item	Symbol	MIN.	TYP.	MAX.	Unit	Test Conditions
Zero Gate Voltage Drain Current	I_{DSS}	—	—	1	μA	V_{DS} = 40 V, V_{GS} = 0 V
Gate Leakage Current	I_{GSS}	—	—	±100	nA	V_{GS} = ±20 V, V_{DS} = 0 V
Gate to Source Threshold Voltage	$V_{GS(th)}$	1.5	1.8	2.5	V	V_{DS} = V_{GS}, I_D = 250 μA
Forward Transfer Admittance *1	$\| y_{fs} \|$	44	88	—	S	V_{DS} = 5 V, I_D = 45 A
Drain to Source On-state Resistance *1	$R_{DS(on)1}$	—	2.45	2.95	mΩ	V_{GS} = 10 V, I_D = 45 A
	$R_{DS(on)2}$	—	3.10	6.20	mΩ	V_{GS} = 4.5 V, I_D = 23 A
Input Capacitance *2	C_{iss}	—	3900	5850	pF	V_{DS} = 25 V V_{GS} = 0 V f = 1 MHz
Output Capacitance *2	C_{oss}	—	530	800	pF	
Reverse Transfer Capacitance *2	C_{rss}	—	200	360	pF	
Turn-on Delay Time *2	$t_{d(on)}$	—	18	40	ns	V_{DD} = 20 V, I_D = 45 A V_{GS} = 10 V R_G = 0 Ω
Rise Time *2	t_r	—	8	21	ns	
Turn-off Delay Time *2	$t_{d(off)}$	—	71	142	ns	
Fall Time *2	t_f	—	9	23	ns	
Total Gate Charge *2	Q_G	—	68	102	nC	V_{DD} = 32 V V_{GS} = 10 V I_D = 90 A
Gate to Source Charge	Q_{GS}	—	17	—	nC	
Gate to Drain Charge	Q_{GD}	—	11	—	nC	
Body Diode Forward Voltage *1	$V_{F(S-D)}$	—	0.9	1.5	V	I_F = 90 A, V_{GS} = 0 V
Reverse Recovery Time	t_{rr}	—	43	—	ns	I_F = 90 A, V_{GS} = 0 V di/dt = 100 A/μs
Reverse Recovery Charge	Q_{rr}	—	59	—	nC	

Note: *1 Pulsed test
Note: *2 Not subject of production test. Verified by design/characterization.

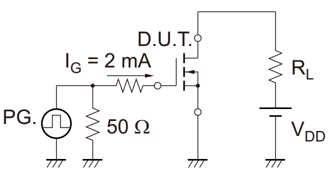
TEST CIRCUIT 1 AVALANCHE CAPABILITY



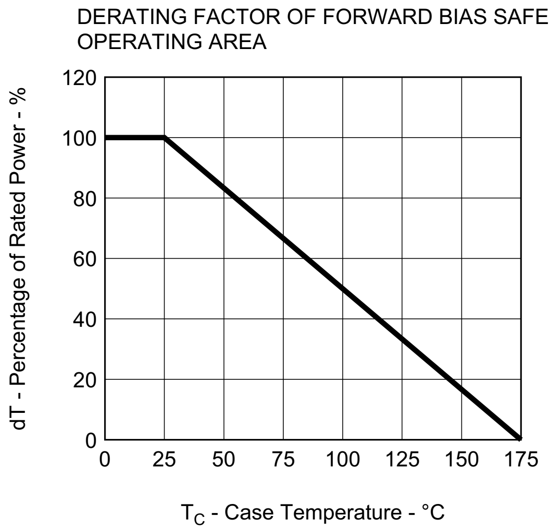
TEST CIRCUIT 2 SWITCHING TIME

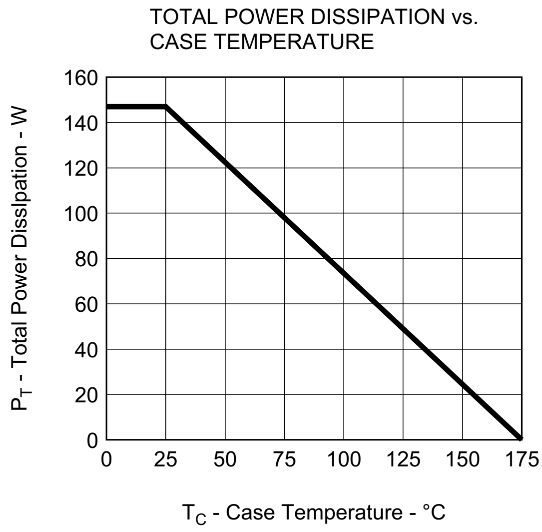


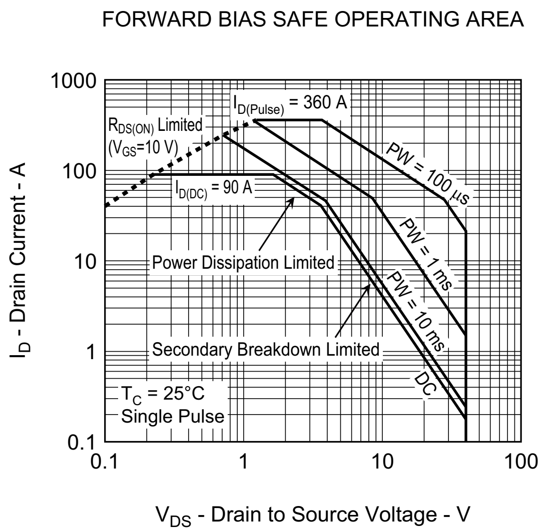
TEST CIRCUIT 3 GATE CHARGE

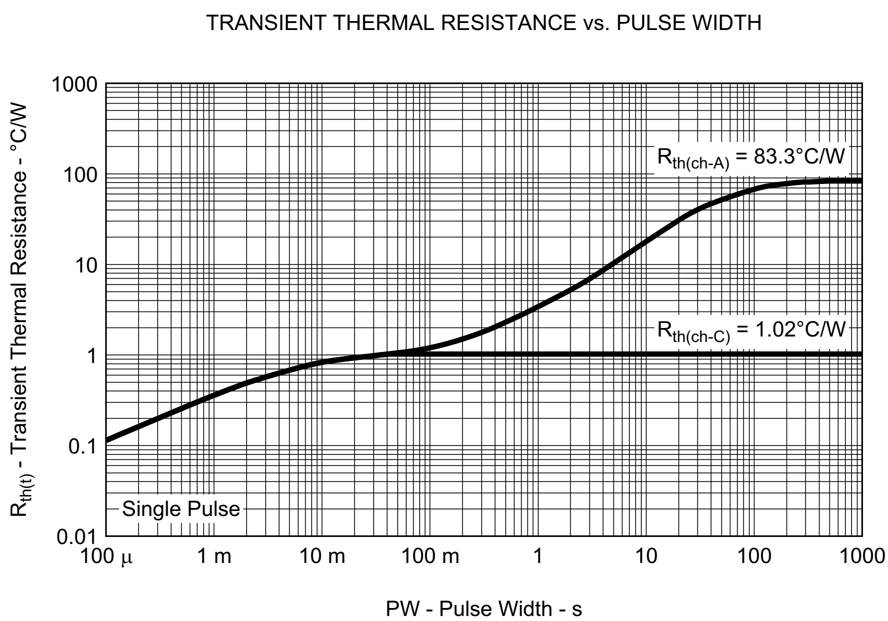


Typical Characteristics (T_A = 25°C)

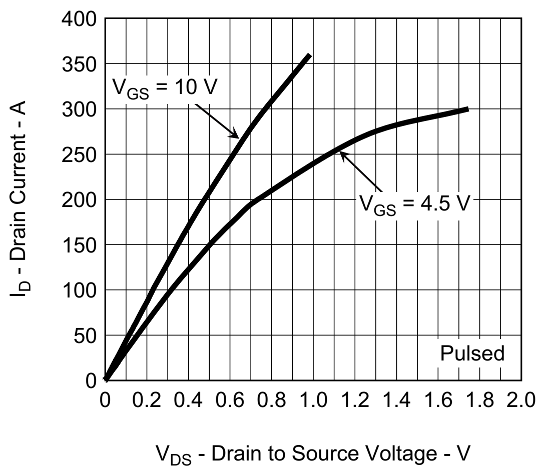




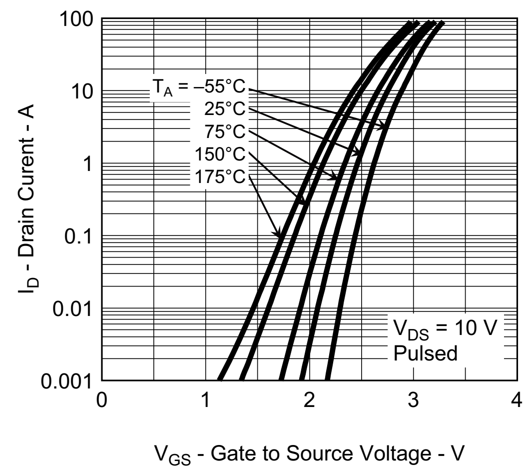




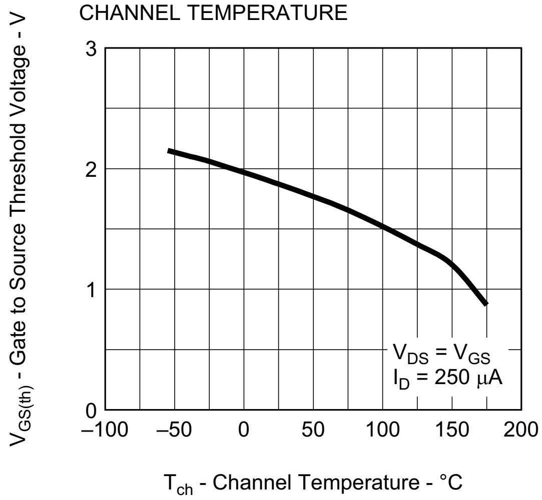
DRAIN CURRENT vs.
DRAIN TO SOURCE VOLTAGE



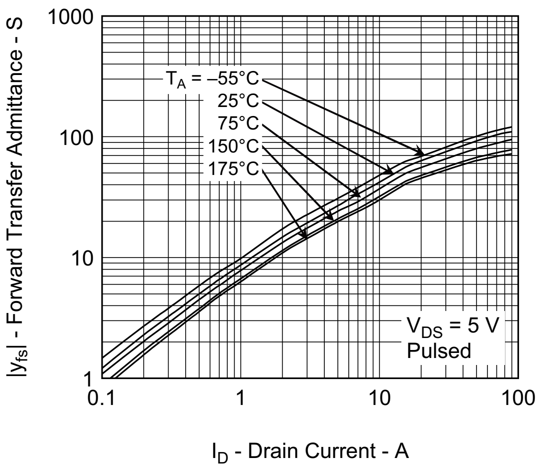
FORWARD TRANSFER CHARACTERISTICS



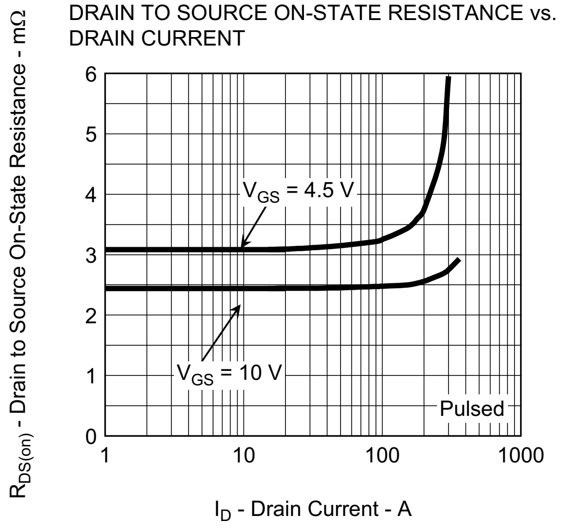
GATE TO SOURCE THRESHOLD VOLTAGE vs.
CHANNEL TEMPERATURE



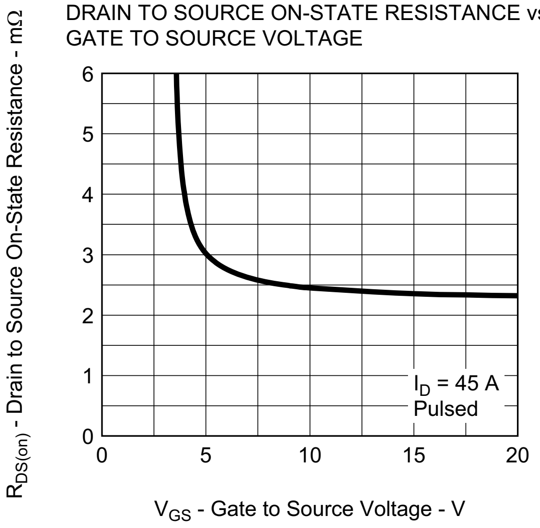
FORWARD TRANSFER ADMITTANCE vs.
DRAIN CURRENT



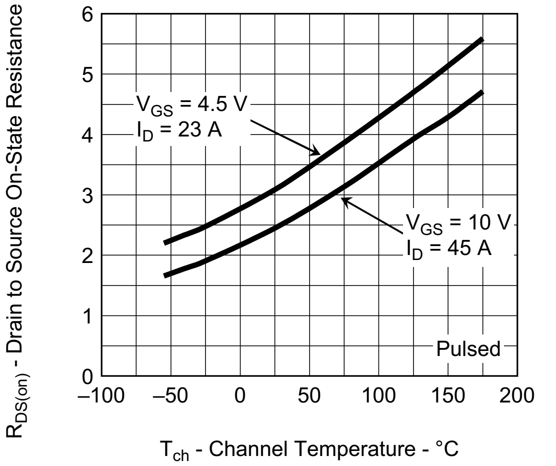
DRAIN TO SOURCE ON-STATE RESISTANCE vs.
DRAIN CURRENT



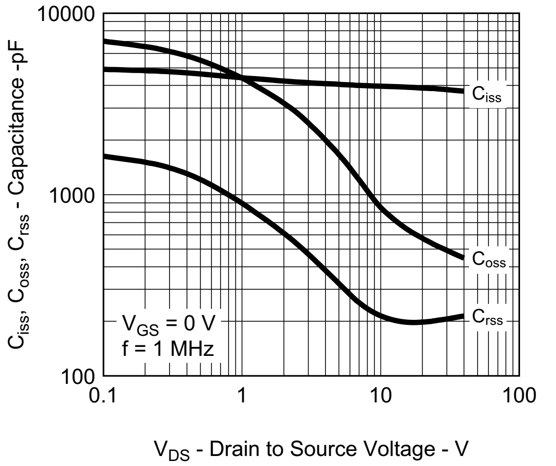
DRAIN TO SOURCE ON-STATE RESISTANCE vs.
GATE TO SOURCE VOLTAGE



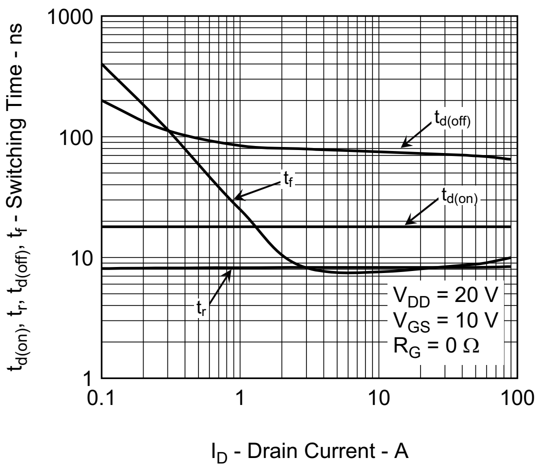
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



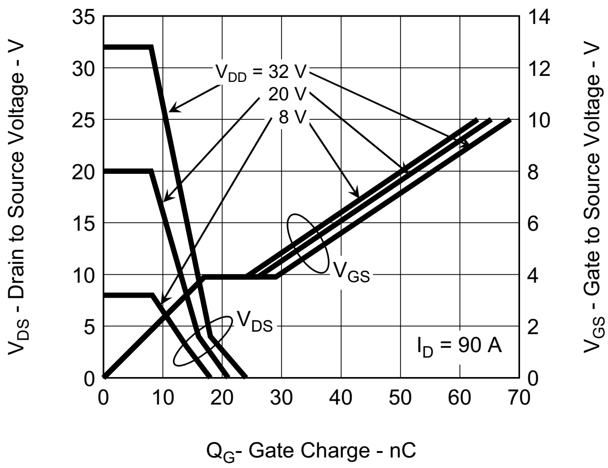
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



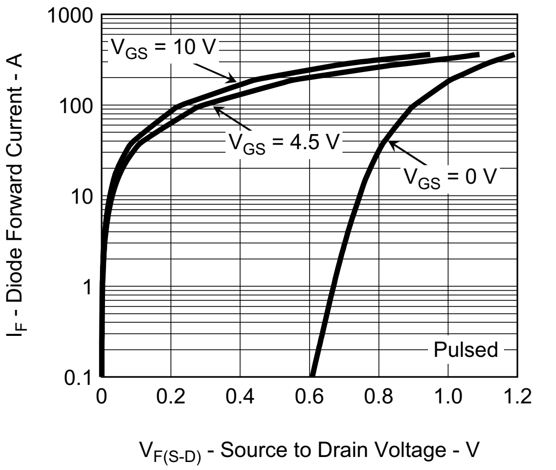
SWITCHING CHARACTERISTICS



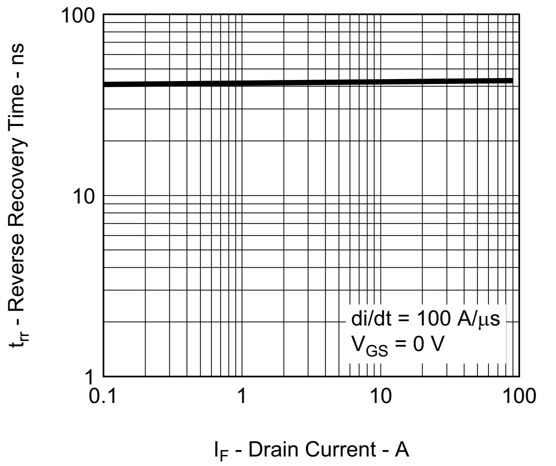
DYNAMIC INPUT/OUTPUT CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE

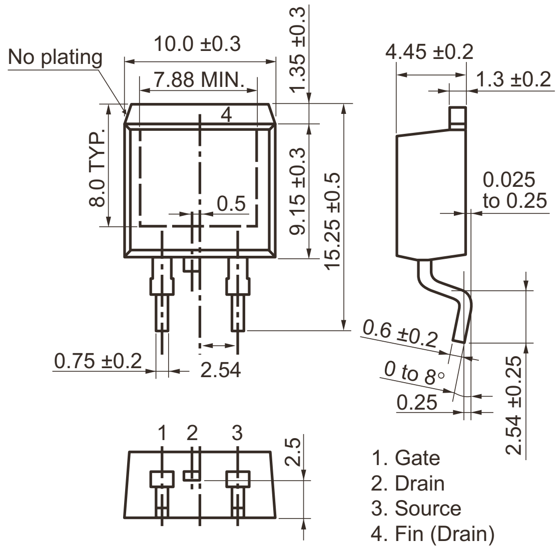


REVERSE RECOVERY TIME vs. DRAIN CURRENT

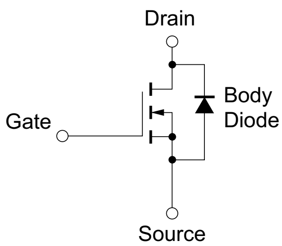


Package Drawing (Unit: mm)

TO-263 (MP-25ZP) (Mass: 1.48 g TYP.)



Equivalent Circuit



Remark: Strong electric field, when exposed to this device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred.

Revision History	NP89N04PDK Data Sheet

Rev.	Date	Description	
		Page	Summary
1.00	Feb 21, 2013	—	First Edition Issued
2.00	May 24 ,2018	1	Note 3 was added
		2	Note 2 was added

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